

Pixel Barrel Module Alignment Using Overlaps

Wei-Ming Yao (LBNL)

ATLAS IDWeek, 2/10/2009

- Develop alternative strategy that provides cross check and ultimately improve the pixel alignment.
- Constraining the neighboring modules together using overlaps.
- Overlap is defined for a track passing through two neighboring modules in the same layer and in the same eta ring.
- Advantage of this reduces a large number of modules into a small number of regions that requires fewer degrees of freedom to solve in the global χ^2 .



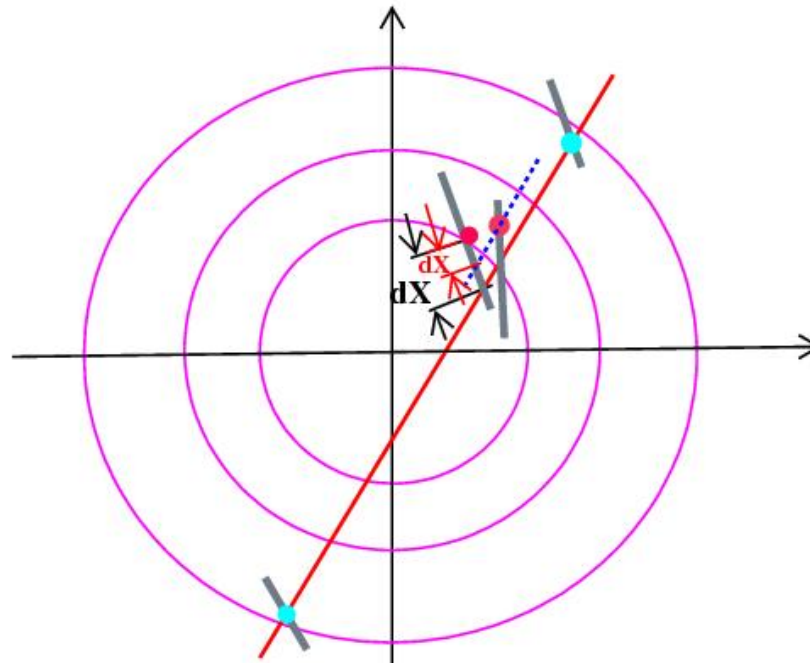
Datasets and Event Selections

- Using most of cosmic bfield off data from Max, about 180K.
- Reprocessed with default cosmic tracking with latest cosmic 03 alignment file.
- Selections:
 - Cluster size < 5 and no duplicated events.
 - At least three pixel hits and two far apart hits on layer 2.
- Recomputing the cluster positions with GLX2.7 alignment file (Vicente).

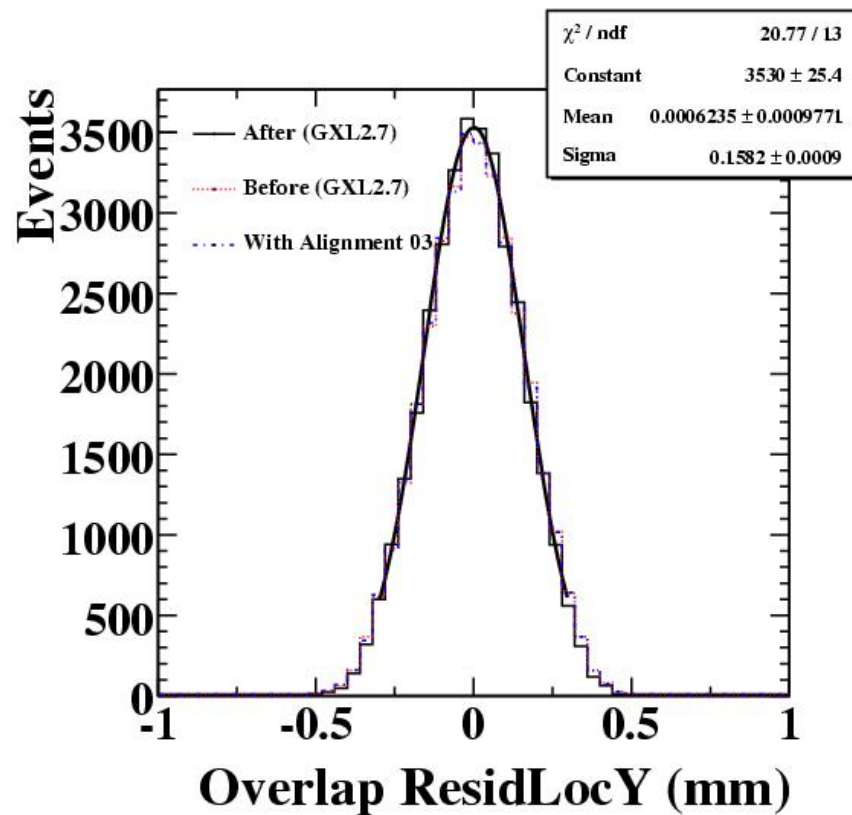
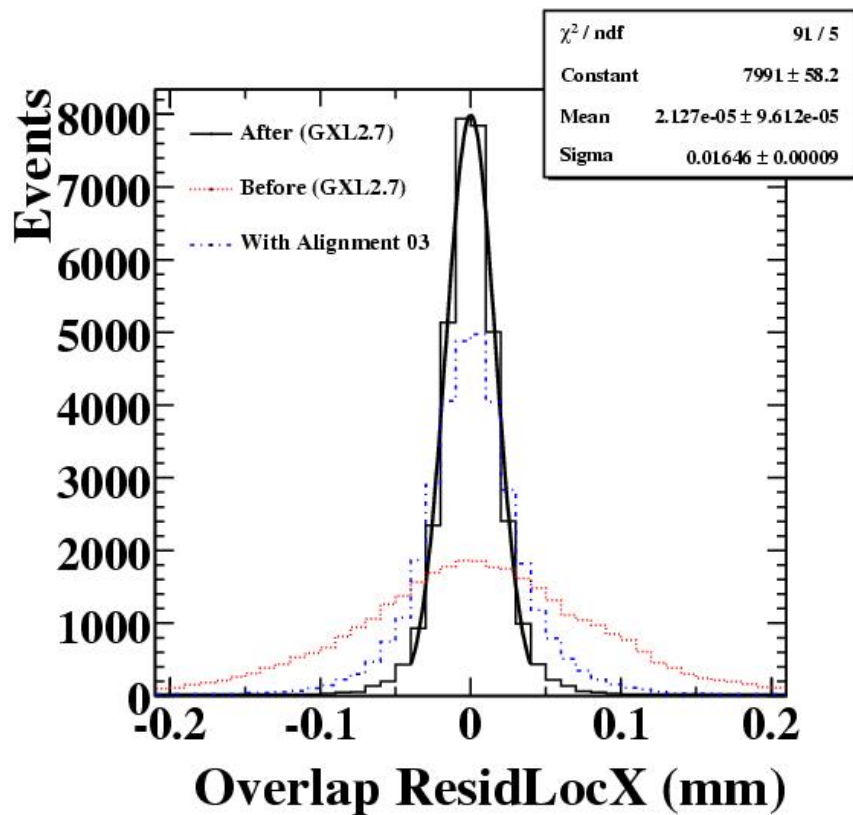


Alignment Strategies

- Step 1: Constraining the relative misalignment between neighboring modules using **overlap residuals**.
- Step 2: Starting two far hits on layer 2 and propagating into layer 0 and 1
- $\chi^2 = \sum (x_{exp} - x_{hit})^2 / \sigma_x^2 + (y_{exp} - y_{hit})^2 / \sigma_y^2$
- Minimizing the χ^2 in terms of misalignments on the considered module and the modules on layer2.
- There are 86 regions with 5 degrees of freedom each that gives a 430 x 430 matrix to solve in the global χ^2 fit.



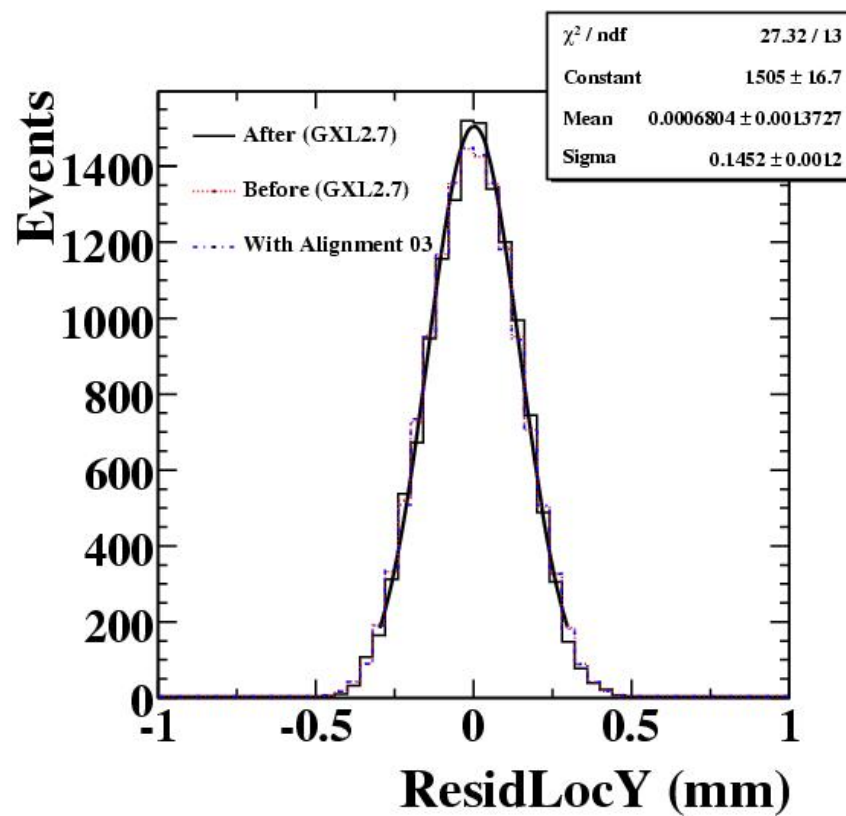
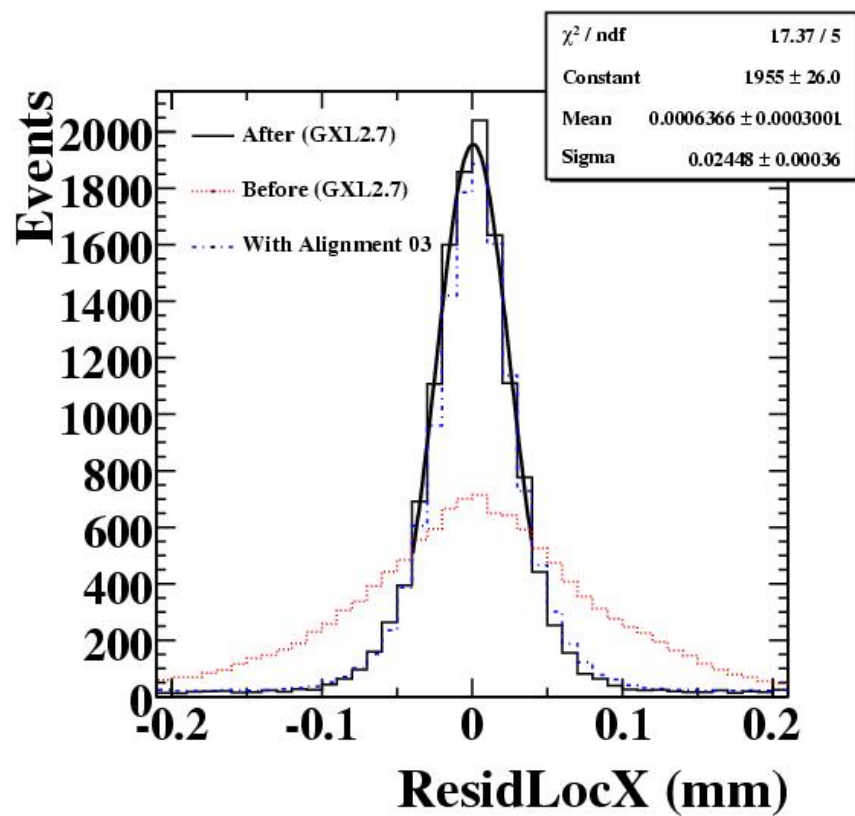
Overlap Residuals after Correction (GXL2.7)



	GXL2.7	Alignment 03	After Correction
Loc σ_X (μm)	77	25.6	16.5
Loc σ_Y (μm)	162	162	158



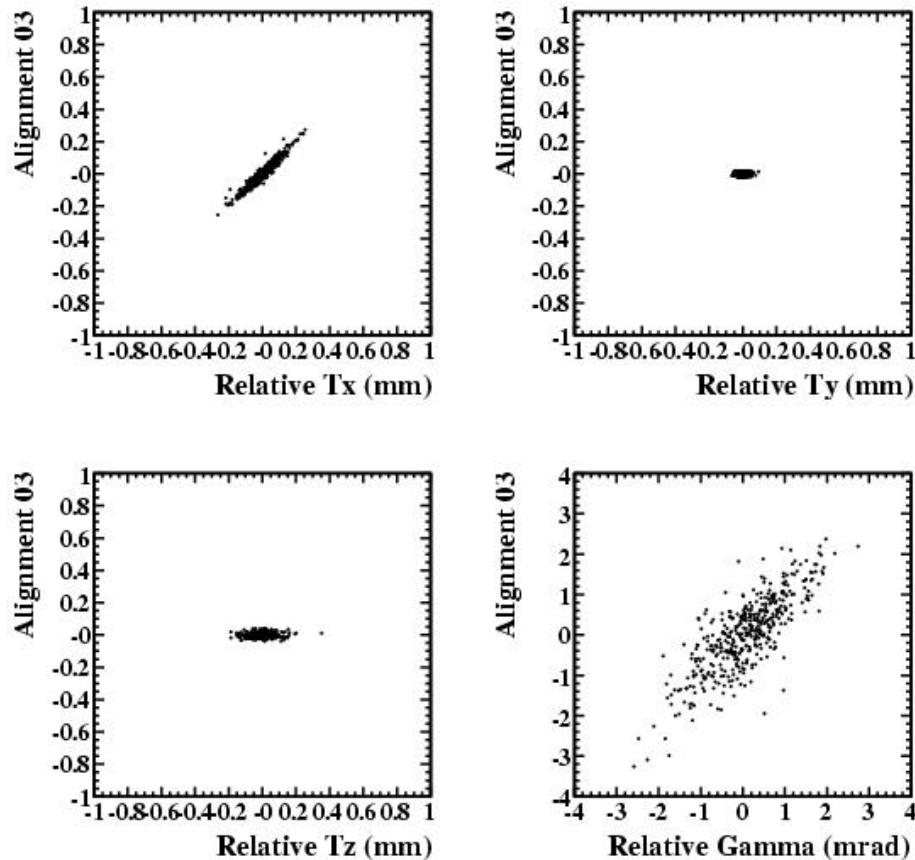
Residuals of layer 0 and 1 after Correction (GXL2.7)



	GXL2.7	Alignment 03	After Correction
Loc σ_X (μm)	73	25.4	24.5
Loc σ_Y (μm)	151	151	145



Relative Alignment Constants Between Overlaps



- Compared relative L3 alignment from overlaps(x axis) to “alignment 03” (y axis).
- The agreement seems good.



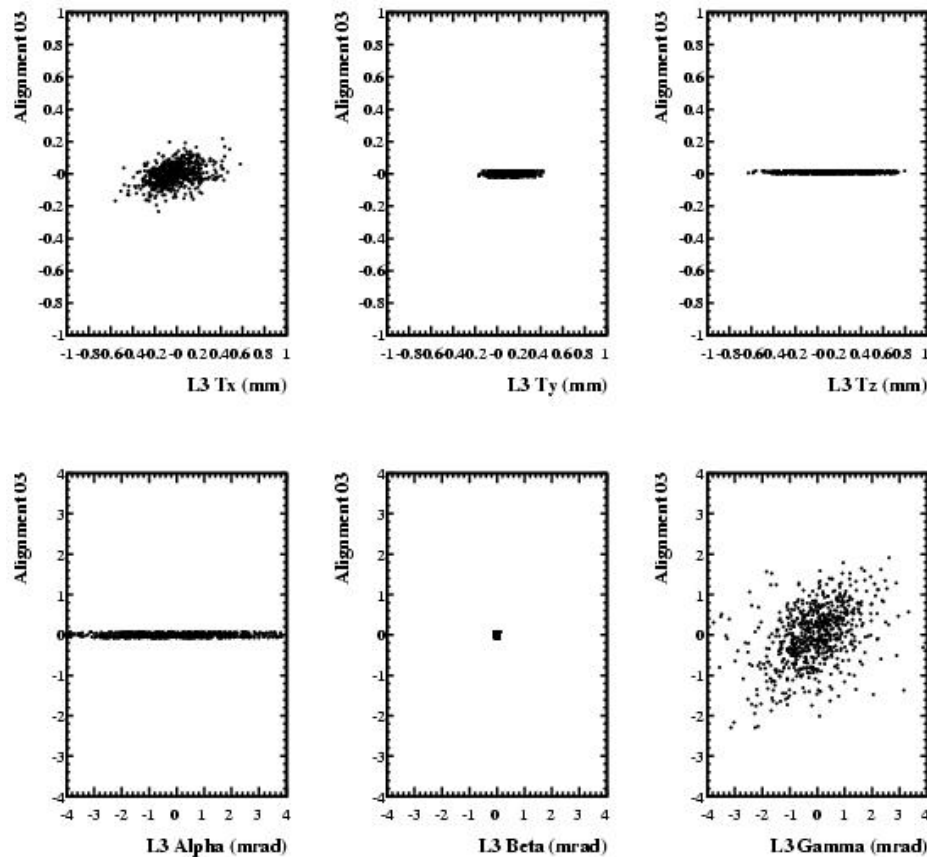
The Degrees of Freedom of Module

Number of DOF	Loc σ_X (μm)	Loc σ_Y (μm)
T_X	23.1	159
T_X, γ	18.8	160.1
T_X, T_Z, γ	16.5	156
T_X, T_Y, T_Z, γ	16.1	154
$T_X, T_Y, T_Z, \alpha, \beta, \gamma$	16.2	153

- The overlap residual is more sensitive to the misalignment than tracking errors.
- It seems improve significant with additional degree of freedom.



Comparison Final L3 Alignment Constants



- Compared L3 alignment after global fit (x axis) to “alignment 03” (y axis).
- There seem some correlations in x and γ , but...



Conclusion

- The alternative alignment strategies using overlaps seem promising and give comparable results.
- The overlap residual seem much better, but not much in residuals of layer 0 and 1.
- The module L3 constants seem correlated with cosmic 03 and hopefully understanding the differences could result in a better pixel alignment.
- More work is underway to understand the pixel resolution using overlaps.

